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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of

Kiril A. Pandelisev

Serial No. 09/881,104

Filed: June 15, 2001

Art Unit: 2878

Examiner: A. Gagliardi

For: FIBER OPTIC ENHANCED SCINTILLATOR DETECTOR

APPEAL BRIEF

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REAL PARTY IN INTEREST

PHOENIX SCIENTIFIC CORPORATION is the real party in interest in the above-identified case by virtue of an assignment filed June 15, 2001, and recorded on Reel/Frame 011906/0457.

RELATED APPEALS AND INTERFERENCES

No other related appeals or interferences are pending at this time.

STATUS OF CLAIMS

Claims 1-8, 10-12, 15, 23-32, 34-41, 43-45, 55-63, 65, 66 and 148-153 were finally rejected over prior art.

Claims 9, 13, 14, 16-22, 33, 42, 46-54, 64, 67-147 and 154-177 were withdrawn from consideration.

A copy of the appealed claims is appended hereto in the CLAIMS APPENDIX.

STATUS OF AMENDMENTS

Amendments proposed after the final Office Action were not entered pursuant to an Advisory Action dated January 12, 2005.

SUMMARY OF CLAIMED SUBJECT MATTER

New scintillation detectors provided crystals or other scintillators with one or more optical fibers to conduct photons to photoactive devices such as, for example, photodiodes, photomultiplier tubes or other photon reactive devices. Photons are conducted to the detectors or photoactive devices through lenses, micro lenses and/or through collimators. (Specification page 1, lines 14 – 19).

One preferred form of the crystal scintillator uses optical fibers and micro lenses to direct photons to the photoactive devices. (Specification page 1, lines 20 – 22).

The scintillators, which preferably are doped crystals, produce the photons upon being energized by particles, energy or rays, especially gamma rays. The new scintillators are connected at one or more points or on one or more sides or faces, or on any or all sides to conductors which are collimators, lenses or fiber ends. Optical fibers in cables conduct the photons generated by the crystal scintillators to photon-actuated devices. The devices may be mounted near the crystal scintillators or remote from the crystal scintillators, for example on surfaces near drilled wells or exploration holes. The crystals or scintillators have any of several cross-sections. Down hole detectors or detectors used in other adverse conditions are ruggedized, with rugged flexible outer cases which are transparent to the looked-for energy, particles or rays, gamma rays for example. Inner scintillator construction allows bending, twisting and flexing without damaging scintillator arrays, individual scintillators, lenses or fiber optic connections. (Specification page 1, line 23 to page 2, line 15).

In one preferred form of the invention, a plurality of smaller crystals or scintillators are connected with optical fibers in cables to photon-activated devices. Preferably a plurality of the

smaller crystals or scintillators is connected with optical fibers to one photon-active device, for example a photodiode, photomultiplier, or other photon-receiving device. Each crystal or scintillator delivers an optical signal to the same one or more photosensors. If one of the smaller crystals or scintillators is cracked or scratched or is otherwise rendered defective, such as by rough handling, the entire signal of the scintillator array is not greatly diminished. (Specification page 2, line 16 to page 3, line 2).

By dividing the crystal or scintillator into a plurality of smaller crystals, the likelihood of cracking or injuring the crystals is reduced. The array is flexible and is capable of bending, twisting and absorbing shock, such as encountered in down hole operations, for example. (Specification page 3, lines 3 – 7).

The structural package of the smaller crystals may include from a few crystals up to many crystals, for example five or fewer crystals to fifty crystals, or more. (Specification page 3, lines 8 – 10).

The small crystals in the array may be constructed in any cross-sectional configuration and may be packed, for example, in a stacked array of sloped crystals within a tubular sheet to provide flexing, impact-absorbing, bending and twisting in response to external impacts and without damaging the array, individual crystals within the array or optical fiber connections to the crystals. (Specification page 3, lines 11 – 17).

The plurality of smaller crystals are arranged in arrays, such that the entire detector is flexible in its longitudinal axis, and also such that the entire array twists without affecting the

results and without damaging the individual smaller crystals and optical fiber connectors. (Specification page 3, lines 18 – 22).

Each small crystal is an optically optimized scintillator in itself. (Specification page 3, lines 23 – 24).

Each small crystal may be coupled to an optical fiber output at one surface or more than one surface. (Specification page 4, lines 1 – 2).

Optical fibers may be made of optical scintillator materials which strengthen the signals moving through the optical fibers, increasing light energy while transmitting the input photons. (Specification page 4, lines 3 – 5).

One preferred form of the invention uses gamma camera plates coupled to fibers through micro lens arrays. (Specification page 4, lines 6 – 7).

In preferred embodiments optical fibers connected to the scintillators are bundled with remote object illuminators and image viewing fibers for viewing insides of wells and bores, patients or welds being inspected. (Specification page 4, lines 8 – 11).

In one embodiment, the scintillation crystals are individually isolated detectors. The crystals can be connected by an elastomer. Preferably the crystals/detectors are interconnected by an optically transparent or translucent elastomer and then are connected to a fiber optic cable or to a fiber optic cable bundle. (Specification page 4, lines 12 – 17).

In one embodiment, the scintillation crystal assembly has an optical viewing portion that allows the operator to view the assembly and other parts from a distance. The optical viewing portion has light sources at one or both ends and employs micro lenses, lenses, shaped light

guides, and other optical components to provide for sharp images of the parts being viewed. The viewing is for observation purposes or for shape and size measurement purposes, and for purposes of certain control functions to be performed. (Specification page 4, line 18 to page 5, line 2).

Well logging devices have scintillation measurement and optical measurement capabilities using this approach. The image the data are analyzed at distance, or they are converted into other signals and transmitted with or without signal transmission lines. (Specification page 5, lines 3 – 7).

Using the coupled viewing system in gamma camera device applications, a user remotely views the patient being examined in real time, or the image signal is recorded while the gamma ray examination takes place. (Specification page 5, lines 8 – 11).

Remote gamma ray or other high energy rays or particle measuring tools having optical viewing capabilities use this combined tool. Weld inspection units are capable of examination of the weld quality and visual inspection before, during and after the tests. (Specification page 5, lines 12 – 16).

Remote gamma ray, X-ray, high energy particle tools having visual inspection are used in radioactive storage tank applications, automotive industry applications, and other industrial tools for measurement of high energy rays or particles, or measurements using such high energy rays or particles for structural integrity, density, uniformity and similar applications. (Specification page 5, lines 17 – 23).

Combinations of light sources, X-ray sources, X-ray detectors and visual inspection capabilities are included. (Specification page 6, lines 1 – 2).

Referring to Figures 1 and 2, a scintillator detector 10 has a body 11. In the example, a generally truncated conical body with a sidewall angle alpha assists in directing the photons generated by internal scintillations toward the spheroidal lens-like ends 13 and 15 of the body 11. The concave or convex shaped lens surface ends 13 and 15 cooperate with the collimators 17 and 19. The collimators direct the photons generated in the scintillator 10 to single or multiple optical fibers 21 and 23. The single or multiple optical fibers are made from quartz or any other material which conducts the light energy which is directed into the ends 25 and 27 of the fibers. The photons generated within scintillator body 11 are directed to the ends 25 and 27 of the optical fibers. The sloped wall 31 of the scintillator body 11 reflects the photons out of the ends or back into the scintillator. The curved end walls 13 and 15 refract the photons. The sloped walls 33 and 35 of the collimators 17 and 19 reflect the photons toward the ends 25 and 27 of the optical fibers 21 and 23. (Specification page 8, line 18 to page 9, line 12).

The length of the fibers can be long and can control dark current related problems. Low attenuation fibers connect scintillators in wells and test holes deep below the surface to photon-activated devices, such as photomultiplier tubes, on the surface. (Specification page 9, lines 13 – 17).

The cross-section of the scintillator body 11 may be circular, elliptical, rectangular, hexagonal or any other regular or irregular shape. The angle alpha of the walls 31 of the scintillator body 11 are any angles between -180° and 180°. The angles beta of the collimator

walls 33 and 35 are angles between -180° and 180°. The radii R1 and R2 of the optical coupler surfaces 13 and 15 have any concave or convex curvature which promotes the transmission and refraction of photons to direct the impingement of the photons on ends 25 and 27 of the single or multiple optical fibers 21. (Specification page 9, line 18 to page 10, line 3).

The optical couplers 33 and 35 preferably are made of optically transparent elastomers to focus the electrons, while cushioning vibrations in ruggedized structures, for example in down hole oil well logging applications. (Specification page 10, lines 4 – 7).

As shown in Figure 2, the optical couplers 13 and 15 may be formed with micro lenses 37 and 39, which reflect and focus the photons from scintillator body 11 to the ends 25 and 27 of the single or multiple optical fibers. Alternatively, the individual lenses 37 and 39 are connected to one or more individual fibers 41 and 43 which are ends of the multiple fibers 21 and 23. In that case, the individual fibers extend from the ends 25 and 27 to the individual multiple micro lenses 37 and 39 in the arrays which form the curved optical couplers 13 and 17 on the longitudinal ends of the scintillator body 11. (Specification page 10, lines 8 – 17).

As shown in Figures 1 and 2, the single or multiple fibers 21 and 23 may be connected to the inputs of a single photon-activated device, such as a photomultiplier tube. The fibers 21 and 23 may be connected to multiple photon-activated devices. The former is preferred as a way to save costs and to promote compactness of the equipment. (Specification page 10, lines 18 – 23).

The axial lengths H1 and H2 of the scintillator body 10 and the collimator 17 are coordinated to focus protons from the scintillator body 11 to the end 25 of the single or multiple

optical fiber 21. Preferably H1 is greater than H2 to provide the maximum scintillator dimensions within a fixed overall length. (Specification page 11, lines 1 – 6).

Referring to Figure 3, a scintillator 10 has a body 11. A curved optical coupler end 13 may have a micro lens array. A collimator 17 may be a clear elastomeric body or an expansion of the optical fibers 21. (Specification page 11, lines 7 – 10).

The single or multiple optical fibers 21 have at the second end 45 a solid transparent piece 47, preferably of an elastomeric transparent material, or a fiber geometry 49, which connects the single or multiple fibers 21 to a photo-active device 50 such as a photomultiplier tube 51. The photomultiplier tube is surrounded by a thermal electric cooler 53 and a magnetic shield 55. The magnetic shield 55 and the thermal electric cooler, which may be a Peltier cooler, reduce unwanted dark currents. The use of small dynodes within the photomultipliers operate to lower or eliminate dark currents within the photomultiplier which interfere with the precise output of the photomultiplier tubes. (Specification page 11, lines 11 – 21).

In Figure 4 the thermal electric cooler 53 and the magnetic shield 55 surround the preamplifier 57, as well as the entire photomultiplier tube 51. (Specification page 11, lines 22 – 24).

Referring to Figure 5, an array 60 of a plurality of optically optimized scintillators 61 is mounted within a gamma ray-transparent flexible ruggedized case 63. Each scintillator 61 has one or more optical fibers 65 connected to the multiple optical fiber 21. The upper scintillator 67 is connected with a coupling 69 at the top. Lower scintillators 71 are connected with couplings 73 at the sides. Each scintillator 61 within the array preferably is directly coupled to the

photomultiplier 51 through the fibers which extend directly to the input of the photomultiplier. The photomultiplier may be any photodetector, such as a diode or other photo-reactive device. Each scintillator may be connected to single or multiple optical fibers. (Specification page 12, lines 1 – 13).

As shown in Figure 6, the coupling may be a coupling 69 from the top of the scintillator 61, or a coupling 73 or 72 from either or both sides of the scintillator 61, a coupling 75 from the bottom of a scintillator device, or a coupling 77 from one side and the bottom of the scintillator device. Each scintillator has a cross-section which is selected from any conceivable cross-section. (Specification page 12, lines 14 – 20).

Some of the preferred cross-sections 80 are shown in Figure 7, for example square cross-section 81, polygonal cross-section 83, rectangular cross-section 85, elliptical cross-section 87 and circular cross-section 89. Any of these cross-sections or combinations of the cross-sections is suitable for the scintillators 61. (Specification page 12, line 21 to page 13, line 2).

As shown in Figures 8, 9 and 10, an array 90 of optically optimized scintillators 91 is shown in an overlying sloped arrangement arranged axially within a gamma ray transparent ruggedized tube 93. Each scintillator 91 has an end optical coupler 95 which is connected to one or more optical fibers 97 to connect the individual scintillators 91 to the single or plurality of optical fibers 21, and thence through the connectors 47 or 49 to the photodetector. Photomultiplier tube 51, with preamplifier 57, is cooled 53 and screened 55 to reduce or avoid dark currents. (Specification page 13, lines 3 – 12).

Each of the plurality of independent scintillators is coupled with one or more optical sensors embodied in an oil well logging, logging-while-drilling, or other configuration where the scintillator sensitivity, accuracy and viability are required, and the working conditions are rough and can cause sensor damage and inherent signal degradation in less rugged sensors. The combined scintillators are made to be flexible. Flexible plastic scintillators may be used as crystal encasements 99. (Specification page 13, lines 13 – 20).

Coupling scintillators with the fiber optic cable provide needed X and Y coordinates of the signal and simplify supporting electronics in such devices as, for example, gamma camera applications. Micro lens endings of the fibers dramatically reduce the number of fibers employed while preserving and enhancing the transmission of photons. (Specification page 13, line 21 to page 14, line 2).

Referring to Figure 11, a scintillator array 100 includes a number of independent scintillators 101 held within a ruggedized sheath 103. Each scintillator has opposite ends 102 and 104. Collimators 105 and 106 at the opposite ends communicate respectively with multiple optical fibers 107 and 108 to move photons from the scintillators 101 through the ends into the optical fibers 107 and 108, and from those respective fibers through guides 46 and 47 and fibers 48 and 49 into the photomultiplier tubes 51 and 52. (Specification page 14, lines 3 – 11).

The photomultiplier tubes and their respective preamplifiers 57 and 58 are mounted within the electrothermal shields 53. Direct current power, such as from batteries, is supplied to the electrothermal shields 53 to cool the photomultipliers and preamplifiers and to prevent or

reduce dark currents generated autonomously within the photomultipliers. (Specification page 14, lines 12 – 17).

Radio frequency and magnetic field shields 55 surround the photomultipliers 51 and 52 and the preamplifiers 57 and 58 to prevent false readings. (Specification page 14, lines 18 – 20).

Figure 12 shows a gamma ray plate assembly 110 with a gamma ray admitting window 111. An elastomer cushioning layer 113, which has appropriate optical characteristics, is connected between the gamma ray window and the scintillator 115. A glass plate optical window 117 overlies the scintillator. Optical coupler 116 seals the glass plate optical window 117 on the scintillator 115. An optical coupler 118 on top of the glass plate, which may be a micro lens array 119, connects many single or multiple optical fibers 121 to the glass plate. Photons from scintillator 115 pass through the optical couplers 116 and 118 and the glass plate 117. The singular or multiple optical fibers 121 and the fiber optic bundle or cable 123 transfer the photons to the photon-active device, for example a photomultiplier tube. (Specification page 14, line 21 to page 15, line 9).

Figure 13 is a partial top view of a segmented gamma ray plate assembly 110, such as shown in Figure 12. Single or multiple optical fibers 121 have ends 125, which are connected to the optical coupler 118, which may be a micro lens array 119, to pass the photons created by the scintillator 155 through the fiber optic bundle 123. (Specification page 15, lines 10 – 15).

Figure 14 shows a partial cross-sectional view of the structure shown in Figure 13. The dashed lines in Figures 14 and 12 represent multiple connections of the singular multiple optical

fibers 121 to the optical coupler 118 atop the glass plate 117. (Specification page 15, lines 16 – 20).

Figure 15 shows a partial top view of a fiber optic connected single plate, gamma ray detector 110. The single or multiple optical fibers 121 have ends 125 connected to the optical coupler 118 or the multiple micro lenses 119 on top of the glass plate 117 above the scintillator 115. The fiber optic bundle or cable 123 shown in Figure 15 has segmentation 129, which groups the single or multiple optical fibers 121 from distinct areas of the gamma camera ray detector. (Specification page 15, line 21 to page 16, line 4).

Figure 16 shows a scintillator 130 made of plural scintillator crystals 131 in a flexible enclosure 133 which shields the scintillators from light. Each scintillator 131 is connected to one or more optical fibers 135 which are collected in a cable 137. Within or alongside cable 137 is an optical system 139. The optical viewing system 139 includes one or more light directing fibers 141 in a sheath 143 and a terminal lens 145 to direct light 147 on objects near the scintillator 130. One or more image fibers 149 are included in the assembly 150 to return to a viewer illuminated images of the scintillator and objects in areas near the scintillator 130. The same optical viewing system 130 may be used with any of the other scintillators described herein. For example the optical viewing system may be used with the scintillators described with reference to Figures 1 through 11. Similar optical viewing systems may be used with the flat plate scintillators described with reference to Figures 12 through 15 to see the area beneath the plate scintillator for insuring correct positioning and alignment. (Specification page 16, lines 5 – 23).

Referring to Figure 17, the schematic representation of a x-ray or gamma ray inspection unit 160 is shown. The fiber optic cable 161 connects to photo sensors and carries the fiber 163, which receives photons to the photo detectors. Light guide fibers 165 are also contained in the cable, and light transmitting fibers 167 and are bound in the cable 161. A gamma ray, x-ray or particle detector array 169 is mounted in the inspection device. A gamma ray or x-ray source 171 is positioned opposite the gamma ray, x-ray or particle scintillator array 169. Rods 172 may connect the gamma ray and x-ray or particle scintillator array 169 and gamma ray, x-ray or particle source 171. The entire apparatus may be mounted vertically or horizontally on the table 170. an object 173 in which internal inspection is required is placed between the gamma ray, x-ray or particle source 171 and the gamma ray, x-ray or particle detector scintillator array 169. To record or observe the position of object 173 as it is being inspected a light source 175 or a lens, which directs light from the light conducting fibers 165 or, which powers a light source through wires in the cable projects light 176 on the object. Lens 177 connected to optical fibers 167 returns the image to the far end of the cable 161 where the image may be observed and recorded. (Specification page 17, line 5 to page 18, line 3).

As shown in Figure 18, a gamma camera with a patient's visual record capability is generally indicated by numeral 180. (Specification page 18, lines 4 – 5).

A patient 182 is positioned on a gamma camera bed or a chair next to a gamma camera assembly 110. The gamma camera assembly 11 trough the gamma ray window 111 receives the gamma rays 1184, which are produced by a substance in the subject's body, and the rays excite scintillation crystals within the scintillator 115. The optical cover 116 and optical window 117 pass the photons through optical fibers 121 and cable 123 to a detector array. (Specification page 18, lines 5 – 12).

Optical fibers or wires 181 supply a lens or light source 185 to illuminate the subject 182 so that the particular portion of the subject being observed by the gamma camera plate can be recorded through the observation lens 187 and the optical fibers 183. (Specification page 18, lines 13 – 17).

GROUNDS OF REJECTION

The Examiner has objected to the drawings.

Claims 148-150 and 152-153 stand rejected under 35 U.S.C. 112, first paragraph as containing subject matter not supported by the original disclosure.

Claims 3-4, 55-63, 148 and 151-152 stand rejected under 35 U.S.C. 112, second paragraph as failing to particularly point out and distinctly claim the subject matter the Applicant regards as the invention.

Claims 1-6, 10-12, 34-39, 43-45, 65, 66, 148 and 153 stand rejected under 35 U.S.C. 103(a) as being obvious over Reed (U.S. Patent No. 5,313,065) in view of Attix (U.S. Patent No. 5,006,714).

Claims 7-8, 40-41 and 149-150 stand rejected under 35 U.S.C. 103(a) as being obvious over Reed (U.S. Patent No. 5,313,065) in view of Attix (U.S. Patent No. 5,006,714) and further in view of Bourdinaud (U.S. Patent No. 5,103,099).

Claims 15 and 48 stand rejected under 35 U.S.C. 103(a) as being obvious over Reed (U.S. Patent No. 5,313,065) in view of Attix (U.S. Patent No. 5,006,714) and further in view of Bourdinaud (U.S. Patent No. 5,103,099) and further in view of Meisner (U.S. Patent No. 4,904,865).

Claims 23-24 stand rejected under 35 U.S.C. 103(a) as being obvious over Reed (U.S. Patent No. 5,313,065) in view of Attix (U.S. Patent No. 5,006,714) and further in view of Inaba (U.S. Patent No. 5,331,961).

Claims 25-27 stand rejected under 35 U.S.C. 103(a) as being obvious over Reed (U.S. Patent No. 5,313,065) in view of Attix (U.S. Patent No. 5,006,714) and further in view of Inaba (U.S. Patent No. 5,331,961) and further in view of Kaufman (U.S. 2002/00870079 A1).

Claims 28-32 stand rejected under 35 U.S.C. 103(a) as being obvious over Reed (U.S. Patent No. 5,313,065) in view of Attix (U.S. Patent No. 5,006,714) and further in view of Inaba (U.S. Patent No. 5,331,961) and further in view of Kaufman (U.S. 2002/00870079 A1), and further in view of Bourdinaud (U.S. Patent No. 5,103,099).

ARGUMENTS

Allowance of all claims is requested. All of the claims distinguish the invention from the references.

Objections to the Drawings

The drawings adequately show the subject material of claims 133 – 177 (not considered). Figure 4 adequately shows removal of geological material from a subterranean well. Furthermore, the specification describes various "down hole" operations and "well logging devices". (See, for example, specification page 2, lines 8 – 15 and specification page 5, lines 3 – 7, respectively).

The objection to the drawings should be removed.

<u>Claims 148-150 and 152-153 are patentable under 35 U.S.C. 112, first paragraph as containing subject matter supported by the original disclosure.</u>

The 35 U.S.C. 112, first paragraph rejections should be withdrawn. The Applicant's specification would reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention.

It is clear in the application that the Applicant is referring to down-hole deep oil well ruggedized scintillators for use while drilling. For example, see page 13, lines 13 – 20. The specification adequately indicates that the Applicant had possession of the invention at the time of filing.

Furthermore, optical couplers 33 and 35 are described on page 10 and on the next to bottom line of page 9 and are materials that connect optical devices, such as the scintillators to the fibers. This is adequately disclosed in the specification such that one skilled in the relevant art that the inventor, at the time the application was filed, would know that the Applicant had possession of the claimed invention.

Therefore, the rejections under 35 U.S.C. 112, first paragraph should be withdrawn.

Claims 3-4, 55-63, 148 and 151-152 are patentable under 35 U.S.C. 112, second paragraph because they particularly point out and distinctly claim the subject matter the Applicant regards as the invention.

The 35 U.S.C. 112, second paragraph rejections should be withdrawn. The claims are not indefinite because they particularly point out and distinctly claim the subject matter that the Applicant regards as the invention.

The Examiner claims that "long", in claim 3, is a relative term and unclear. However, the specification expressly defines the term "long". For example, the specification identifies and describes fibers, as in claim 3, that are sufficiently long such that the fibers reduce dark currents. (See specification on page 9, lines 13 – 17).

The Examiner also claims that the phrase "the scintillator is ruggedized for use far below an earth surface", in claims 4 and 148, is indefinite. However, the specification describes ruggedized construction for use in oil wells far below an earth surface are described in detail. (See, for example, Figures 8 and 11 and specification page 13, lines 13 – 20 and page 14, lines 3 – 11). Once again, the specification provides adequate description of the proper scope of the word "far" that would particularly point out and distinctly claim the subject matter of the Applicant's invention.

Claims 55 – 63 are not indefinite. There is sufficient antecedent basis for the limitation "the single or multiple optical fibers" in claim 55. Claim 55 is dependent on claim 34. Claim 34 recites the limitation providing "multiple light-conducting optical fibers". Thus, there is proper antecedent basis for the optical fibers in claim 55.

Claims 151 – 152 are not indefinite. There is sufficient antecedent basis for the limitation "a space between the detectors is filled" in claim 151. Claim 151 depends on claim 24, which in

turn depends on claim 1. Claim 1 is a fiber optic enhanced scintillator apparatus where photons are directed out and then received and conducted. The detectors are associated with the receiving apparatus. Thus, there is proper antecedent basis for the optical fibers in claim 151.

Therefore, the rejection based on 35 U.S.C. 112, second paragraph should be withdrawn.

<u>The present claims are patentable under 35 U.S.C. 103.</u>

In considering the patentability of the present invention, it is requested that the Board consider the invention as a whole, consider the scope and content of the prior art as a whole, consider the differences between the claims at issue and the prior art, and consider the level of ordinary skill in the art to which the invention pertains at the time the invention was made. <u>Graham v. John Deere Co.,</u> 148 USPQ 459, 467 (1966).

THE INVENTION AS A WHOLE

The invention considered as a whole is best described by the appended claims.

PRIOR ART AS A WHOLE

The prior art to which the invention pertains is typified by the references of record.

DIFFERENCES BETWEEN THE INVENTION AND THE PRIOR ART

Each of the present claims defines unique features and each is individually patentable over the prior art.

The test in reviewing rejections under 35 U.S.C. 103 in which the examiner has relied on teachings of several references, is whether references, viewed individually and collectively, would have suggested claimed invention to a person possessing ordinary skill in the art, and citing references which merely indicate that isolated elements and/or features recited in the claims are known is not a sufficient basis for concluding that combination of the claimed elements would have been obvious. <u>Ex parte Hiyamizu</u>, 10 USPQ2d 1393-1395 (Board of

Patent Appeals and Inter., 1988); In re Kaslow, 217 USPQ 1089 (Fed. Cir. 1983); In re Deminski, 230 USPQ 313 (Fed. Cir. 1986).

Claims 1-6, 10-12, 34-39, 43-45, 65, 66, 148 and 153 are patentable under 35 U.S.C. 103(a) as being non-obvious over Reed (U.S. Patent No. 5,313,065) in view of Attix (U.S. Patent No. 5,006,714).

The present claims particularly point out new and unobvious features of the invention which are not found in any reference and which would not have been obvious from the references. Nothing in each of the references teaches or suggests the claimed features. Therefore, the references cannot anticipate nor render obvious the present invention as claimed.

Claim 1 is patentable over Reed in view of Attix. Claim 1 teaches a fiber optic enhanced scintillator apparatus, comprising a scintillator for producing photons upon being energized by particles, energy or rays, the scintillator further comprising a scintillator body made of scintillator material, surfaces on the body for directing photons toward a photon output for receiving and conducting the photons produced by the scintillator, and a plurality of light-conducting distinct and elongated optical fibers having a proximal and a distal end, and wherein the proximal end of each fiber is optically coupled to the photon output. These patentable features are not found in the cited references.

Reed teaches a fiber optic radiation monitor with a scintillating optical fiber 20. The scintillating optical fiber has aligned sections, dichroic mirrors 22 and an extension fiber 40, but does not have a single fiber or multiple fibers optically coupled to a scintillator.

Reed does not have the structure as described in the claims of the application. The single optic extension fiber of Reed is attached as a continuation of a scintillating fiber. Reed has an

extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror.

Therefore, Reed does not have fibers connected to a scintillator, does not have photocouplers, and does not have coupling lens arrays as described in the Applicant's claims.

The Examiner has cited Attix as teaching a light conducting means formed from a plurality of fibers. However, there would have been no motivation inherent in Reed or Attix to combine one with the other. It is requested that any rejection based on a combination of Reed and Attix be withdrawn.

"It is impermissible to use the claimed invention as an instruction manual or 'template' to piece together the teachings of the prior art so that the claimed invention is rendered obvious." In re Fritch, 23 USPQ2d 1783, 1784 (CAFC, August 1992), quoting from In re Gorman, 18 USPQ2d 1885, 1888 (Fed. Cir. 1991).

Any attempt to modify the teachings of Reed by adapting Attix's multiple fiber optic bundle, as done in hindsight reconstruction by the Examiner, will do harm to the Reed device, because Reed expressly teaches a single fiber for conducting light. The bundle of optical fibers found in Attix does not correspond to the single fiber in Reed. As stated above, Reed has an extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror. This is not true for Attix. Contrary to the Examiner's contention, merely because the references each teach scintillator detection devices does not necessitate a combination of the references.

Citing In re Gordon, 221 USPQ, 1127, the court pointed out, "the mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification". In re Fritch, 23

USPQ2d 1783, 1784 (CAFC, August 1992). In the same case, In re Gordon, the court found a proposed modification inappropriate for an obviousness inquiry when the modification rendered the prior art reference inoperable for its intended purpose.

In In re Jones, 21 USPQ2d 1941 (Fed. Cir. 1992), the Court reversed the Examiner's obviousness holding because there was no suggestion, either within the references nor in the knowledge generally available to one of ordinary skill in the art, to arrive at the claimed invention. Also the Court pointed out:

> "Conspicuously missing from this record is any evidence, other than the PTO's speculation (if it be called evidence) that one of ordinary skill in the art would have been motivated to make the necessary modifications of the prior art ... to arrive at the claimed ... [invention]" (emphasis supplied). In re Jones, 21 USPQ2d 1941, 1944 (Fed. Cir. 1992).

Claim 1 is patentable over Reed in view of Attix.

Claim 2 is patentable over Reed in view of Attix.

Claim 2 adds patentable features to claim 1, namely, a photon detector connected to the distal end of each of the optical fibers. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 3 is patentable over Reed in view of Attix.

Claim 3 adds patentable features to claim 2, which is dependent on claim 1, namely, that the optical fibers are long for reducing dark current. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 4 is patentable over Reed in view of Attix.

Claim 4 adds patentable features to claim 1, namely, that the scintillator is ruggedized for use far below an earth surface, wherein the optical fibers extend from the scintillator far below the earth's surface to the detector that is mounted above the earth's surface. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 5 is patentable over Reed in view of Attix.

Claim 5 adds patentable features to claim 1, namely, that the scintillator further comprises an optical coupler between the scintillator body and the output. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 6 is patentable over Reed in view of Attix.

Claim 6 adds patentable features to claim 5, which is dependent on claim 1, namely, that the optical coupler further comprises an array of micro lenses for directing photons from the scintillator body toward the output and the proximal end of the optical fibers. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 10 is patentable over Reed in view of Attix.

Claim 10 adds patentable features to claim 2, which is dependent on claim 1, namely, an electronic cooler connected to the detector. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

<u>Claim 11 is patentable over Reed in view of Attix.</u>

Claim 11 adds patentable features to claim 10, which is dependent on claim 1, namely, a magnetic field shielding surrounding the detector and the cooler. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

<u>Claim 12 is patentable over Reed in view of Attix.</u>

Claim 12 adds patentable features to claim 2, which is dependent on claim 1, namely, an electromagnetic field shielding surrounding the detector. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

<u>Claim 34 is patentable over Reed in view of Attix.</u>

Claim 34 is patentable over Reed in view of Attix. Claim 34 teaches a fiber optic enhanced scintillator method, comprising providing a scintillator body made of scintillator material, providing surfaces on the body for directing photons toward a photon output, providing multiple light-conducting optical fibers having proximal and distal ends, connecting proximal ends of the optical fibers to the output for receiving photons from the output, and producing

photons upon a scintillator being energized by subatomic particles, energy or rays. These patentable features are not found in the cited references.

Reed teaches a fiber optic radiation monitor with a scintillating optical fiber 20. The scintillating optical fiber has aligned sections, dichroic mirrors 22 and an extension fiber 40, but does not have a single fiber or multiple fibers optically coupled to a scintillator.

Reed does not have the structure as described in the claims of the application. The single optic extension fiber of Reed is attached as a continuation of a scintillating fiber. Reed has an extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror.

Therefore, Reed does not have fibers connected to a scintillator, does not have photocouplers, and does not have coupling lens arrays as described in the Applicant's claims.

The Examiner has cited Attix as teaching a light conducting means formed from a plurality of fibers. However, there would have been no motivation inherent in Reed or Attix to combine one with the other. It is requested that any rejection based on a combination of Reed and Attix be withdrawn.

Any attempt to modify the teachings of Reed by adapting Attix's multiple fiber optic bundle, as done in hindsight reconstruction by the Examiner, will do harm to the Reed device, because Reed expressly teaches a single fiber for conducting light. The bundle of optical fibers found in Attix does not correspond to the single fiber in Reed. As stated above, Reed has an extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror. This is not true for Attix. Contrary to the Examiner's contention, merely because the references each teach scintillator detection devices does not necessitate a combination of the references.

Claim 34 is patentable over Reed in view of Attix.

Claim 35 is patentable over Reed in view of Attix.

Claim 35 adds patentable features to claim 34, namely, connecting a photon detector to the distal ends of the single or multiple optical fibers. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 36 is patentable over Reed in view of Attix.

Claim 36 adds patentable features to claim 35, which is dependent on claim 34, namely, providing the optical fibers as long optical fibers, and reducing dark current with the long optical fibers. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 37 is patentable over Reed in view of Attix.

Claim 37 adds patentable features to claim 34, namely, ruggedizing the scintillator for use far below an earth's surface, mounting the detector on the earth's surface, extending the optical fibers from the scintillator far below the earth's surface to the detector which is on the earth's surface, and transmitting photons from the scintillator through the optical fibers to the detector. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 38 is patentable over Reed in view of Attix.

Claim 38 adds patentable features to claim 34, namely, providing an optical coupler between the scintillator body and the output. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

<u>Claim 39 is patentable over Reed in view of Attix.</u>

Claim 39 adds patentable features to claim 38, which is dependent on claim 34, namely, providing an array of micro lenses on the optical coupler, and directing photons from the scintillator body through the micro lenses and toward the output and the proximal ends of the single or multiple optical fibers. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

<u>Claim 43 is patentable over Reed in view of Attix.</u>

Claim 43 adds patentable features to claim 35, which is dependent on claim 34, namely, connecting an electronic cooler to the detector. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

<u>Claim 44 is patentable over Reed in view of Attix.</u>

Claim 44 adds patentable features to claim 43, which is dependent on claim 34, namely, surrounding the detector and the cooler with a magnetic field shielding. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 45 is patentable over Reed in view of Attix.

Claim 45 adds patentable features to claim 35, which is dependent on claim 34, namely, surrounding the detector with an electromagnetic field shielding. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 65 is patentable over Reed in view of Attix.

Claim 65 adds patentable features to claim 34, namely, connecting a detector to the distal ends of the optical fibers and cooling the detector with an electronic cooler surrounding the detector. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 66 is patentable over Reed in view of Attix.

Claim 66 adds patentable features to claim 65, which is dependent on claim 34, namely, shielding the detector from magnetic fields by surrounding the detector with magnetic field shielding. This is not obvious from Reed, Attix or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 148 is patentable over Reed in view of Attix.

Claim 148 adds patentable features to claim 1, namely, that the scintillator is ruggedized for use far below an earth surface, wherein the optical fibers extend from the scintillator below

the earth's surface to the detector which is mounted below the earth's surface and at a depth that minimizes the mechanical shock and a the temperature effects on the photosensor. This is not obvious from Reed, Attix or any combination thereof.

This is not a mere design choice. Nothing in Reed suggests this feature of Applicant's invention.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 153 is patentable over Reed in view of Attix.

Claim 153 adds patentable features to claim 34, namely, that the scintillator is ruggedized for use far below an earth surface, wherein the optical fibers extend from the scintillator below the earth's surface to the detector which is mounted below the earth's surface and at a depth that minimizes the mechanical shock and a the temperature effects on the photosensor. This is not obvious from Reed, Attix or any combination thereof.

This is not a mere design choice. Nothing in Reed suggests this feature of Applicant's invention.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

<u>Claims 7-8, 40-41 and 149-150 are patentable under 35 U.S.C. 103(a) as being non-obvious over Reed (U.S. Patent No. 5,313,065) in view of Attix (U.S. Patent No. 5,006,714) and further in view of Bourdinaud (U.S. Patent No. 5,103,099).</u>

The present claims particularly point out new and unobvious features of the invention which are not found in any reference and which would not have been obvious from the references. Nothing in each of the references teaches or suggests the claimed features. Therefore, the references cannot anticipate nor render obvious the present invention as claimed.

<u>Claim 7 is patentable over Reed in view of Attix and further in view of Bourdinaud.</u>

Claim 1 is patentable over Reed and Attix as described above. Claim 7 is ultimately dependent on claim 1 and adds patentable features to claim 1, namely, a second optical coupler connected to the scintillator body remote from the first optical coupler, and a second array of micro lenses in the second optical coupler for directing photons from a second part of the scintillator body to a second output, and further comprising second multiple optical fibers connected to the second output. These patentable features are not found in the cited references. This is not obvious from Reed, Attix, Bourdinaud or any combination thereof.

As described above, Reed teaches a fiber optic radiation monitor with a scintillating optical fiber 20. The scintillating optical fiber has aligned sections, dichroic mirrors 22 and an extension fiber 40, but does not have a single fiber or multiple fibers optically coupled to a scintillator.

Reed does not have the structure as described in the claims of the application. The single optic extension fiber of Reed is attached as a continuation of a scintillating fiber. Reed has an

extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror.

Therefore, Reed does not have fibers connected to a scintillator, does not have photocouplers, and does not have coupling lens arrays as described in the Applicant's claims.

The Examiner has cited Attix as teaching a light conducting means formed from a plurality of fibers. However, there would have been no motivation inherent in Reed or Attix to combine one with the other. It is requested that any rejection based on a combination of Reed and Attix be withdrawn.

Any attempt to modify the teachings of Reed by adapting Attix's multiple fiber optic bundle, as done in hindsight reconstruction by the Examiner, will do harm to the Reed device, because Reed expressly teaches a single fiber for conducting light. The bundle of optical fibers found in Attix does not correspond to the single fiber in Reed. As stated above, Reed has an extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror. This is not true for Attix. Contrary to the Examiner's contention, merely because the references each teach scintillator detection devices does not necessitate a combination of the references.

The Examiner has cited Bourdinaud as suggesting a second optical coupler connected to the scintillator body remote from the first optical coupler, and a second array of microlenses in the optical coupler for directing photons from a second part of the scintillator body to a second output and further comprising second optical fibers connected to the second output.

Bourdinaud has a thin plate 2 of scintillating material that receives radiation through one edge 8, and has fluorescent fibers 4 attached longitudinally along the plate. The fluorescent fibers 4 have portions 6 which are parallel, adjacent and attached to one of the two faces of the

plate. The fluorescent fibers are excited by light on the plate.

No combination of Bourdinaud and Reed or Attix should be made. The law is replete with holdings that an Examiner may not pick elements from references and combine them without some suggestion for their combination arising in the references themselves. The decision to combine various aspects of different references would not have been a matter of "routine design choice" as suggested by the Examiner.

Bourdinaud and Reed would have been mutually exclusive because Bourdinaud uses fluorescing cores in fibers to auto-generate wavelengths after a thin scintillator plate receives radiation at its end. Nothing in Bourdinaud would have suggested combination with Reed.

Even if the references were so combined, both of the references lead away from the invention as specifically set forth in the claims. Bourdinaud's fluorescent fibers, excited by light from one side of the scintillator plate, have nothing to do with Reed or Attix or with the present invention.

Nothing in the references, either singly or in combination, teaches or suggests the claimed features. Therefore, the references cannot anticipate nor render obvious the present invention as claimed.

Claim 1 is patentable over Reed in view of Attix and further in view of Bourdinaud.

Claim 8 is patentable over Reed in view of Attix and further in view of Bourdinaud.

Claims 8 adds patentable features to claim 7, namely, that the first and second outputs and each of the second multiple optical fibers have distal ends connected to a single detector. This is not obvious from Reed, Attix, Bourdinaud or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 40 is patentable over Reed in view of Attix and further in view of Bourdinaud.

Claim 34 is patentable under the same rationale as claim 1 discussed above. Claim 40 adds patentable features to claim 39, which is dependent on claim 34, namely, providing a second optical coupler, and providing a second photon output on the scintillator body remote from the first optical coupler, and providing a second array of micro lenses on the second optical coupler, directing photons from a second part of the scintillator body to the second output, and providing second single or multiple optical fibers having proximal ends connected to the second output. This is not obvious from Reed, Attix, Bourdinaud or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 41 is patentable over Reed in view of Attix and further in view of Bourdinaud.

Claim 41 adds patentable features to claim 40, which is dependent on claim 34, namely, connecting distal ends of the first and second multiple optical fibers to a single detector. This is not obvious from Reed, Attix, Bourdinaud or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 149 is patentable over Reed in view of Attix and further in view of Bourdinaud.

Claim 149 adds patentable features to claim 5, which is dependent on claim 1, namely, that the optical coupler possesses special optical properties and can modify the light wavelength emitted from the scintillator to better match the photosensor. This is not obvious from Reed, Attix, Bourdinaud or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 150 is patentable over Reed in view of Attix and further in view of Bourdinaud.

Claim 150 adds patentable features to claim 5, which is dependent on claim 1, namely, that the optical coupler possesses special optical properties and can modify the light wavelength emitted from the scintillator to better match the photosensor. This is not obvious from Reed, Attix, Bourdinaud or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

<u>Claims 15 and 48 are patentable under 35 U.S.C. 103(a) as being non-obvious over Reed (U.S. Patent No. 5,313,065) in view of Attix (U.S. Patent No. 5,006,714) and further in view of Bourdinaud (U.S. Patent No. 5,103,099) and further in view of Meisner (U.S. Patent No. 4,904,865).</u>

The present claims particularly point out new and unobvious features of the invention which are not found in any reference and which would not have been obvious from the references. Nothing in each of the references teaches or suggests the claimed features. Therefore, the references cannot anticipate nor render obvious the present invention as claimed.

<u>Claim 15 is patentable over Reed in view of Attix and further in view of Bourdinaud and further in view of Meisner.</u>

Claim 1 is patentable over Reed and Attix and Bourdinaud as described above. Claim 15 adds patentable features to claim 1, namely, a second output and first and second elastomeric optical coupler bodies connected to the scintillator body at different portions thereof for delivering photons from the scintillator body to the outputs, and for cushioning vibrations and impacts encountered by the scintillator. These patentable features are not found in the cited references. This is not obvious from Reed, Attix, Bourdinaud, Meisner or any combination thereof.

The combination of four separate references to find obviousness seems excessive. The Applicant believes that the Examiner's need to use so many references just to assemble the Applicant's invention in hindsight renders the Applicant's invention non-obvious.

As described above, Reed teaches a fiber optic radiation monitor with a scintillating optical fiber 20. The scintillating optical fiber has aligned sections, dichroic mirrors 22 and an

extension fiber 40, but does not have a single fiber or multiple fibers optically coupled to a scintillator.

Reed does not have the structure as described in the claims of the application. The single optic extension fiber of Reed is attached as a continuation of a scintillating fiber. Reed has an extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror.

Therefore, Reed does not have fibers connected to a scintillator, does not have photocouplers, and does not have coupling lens arrays as described in the Applicant's claims.

The Examiner has cited Attix as teaching a light conducting means formed from a plurality of fibers. However, there would have been no motivation inherent in Reed or Attix to combine one with the other. It is requested that any rejection based on a combination of Reed and Attix be withdrawn.

Any attempt to modify the teachings of Reed by adapting Attix's multiple fiber optic bundle, as done in hindsight reconstruction by the Examiner, will do harm to the Reed device, because Reed expressly teaches a single fiber for conducting light. The bundle of optical fibers found in Attix does not correspond to the single fiber in Reed. As stated above, Reed has an extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror. This is not true for Attix. Contrary to the Examiner's contention, merely because the references each teach scintillator detection devices does not necessitate a combination of the references.

The Examiner has cited Bourdinaud as suggesting a second optical coupler connected to the scintillator body remote from the first optical coupler, and a second array of microlenses in the optical coupler for directing photons from a second part of the scintillator body to a second

output and further comprising second optical fibers connected to the second output.

Bourdinaud has a thin plate 2 of scintillating material that receives radiation through one edge 8, and has fluorescent fibers 4 attached longitudinally along the plate. The fluorescent fibers 4 have portions 6 which are parallel, adjacent and attached to one of the two faces of the plate. The fluorescent fibers are excited by light on the plate.

No combination of Bourdinaud and Reed or Attix should be made. The law is replete with holdings that an Examiner may not pick elements from references and combine them without some suggestion for their combination arising in the references themselves. The decision to combine various aspects of different references would not have been a matter of "routine design choice" as suggested by the Examiner.

Bourdinaud and Reed would have been mutually exclusive because Bourdinaud uses fluorescing cores in fibers to auto-generate wavelengths after a thin scintillator plate receives radiation at its end. Nothing in Bourdinaud would have suggested combination with Reed.

Even if the references were so combined, both of the references lead away from the invention as specifically set forth in the claims. Bourdinaud's fluorescent fibers, excited by light from one side of the scintillator plate, have nothing to do with Reed or Attix or with the present invention.

Meisner has a photomultiplier within the drill head and sends electrical signals to the surface. Meisner suggests placing a photomultiplier tube in the drill head. This is contrary to the Applicant's invention and would thus lead away from the invention, and would thus lead away from combination with the other references. There is no motivation to combine Meisner with the other cited references.

Nothing in the references, either singly or in combination, teaches or suggests the

claimed features. Therefore, the references cannot anticipate nor render obvious the present invention as claimed.

Claim 1 is patentable over Reed in view of Attix and further in view of Bourdinaud and further in view of Meisner.

Claim 48 is patentable over Reed in view of Attix and further in view of Bourdinaud and further in view of Meisner.

Claim 48 has been withdrawn from consideration as indicated in the Advisory Action dated January 12, 2005. However, the Examiner has argued claim 48 in the final Office Action dated June 7, 2004. For the sake of completeness, the Applicant will argue claim 48.

Claim 34 is patentable under the same rationale as claim 1 discussed above. Claim 48 adds patentable features to claim 34, namely, providing elastomeric optical coupler bodies and photon outputs on the scintillator body at opposite portions thereof, delivering photons from the scintillator body to outputs, and cushioning vibrations and impacts encountered by the scintillator with the elastomeric optical coupler bodies. This is not obvious from Reed, Attix, Bourdinaud, Meisner or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claims 23-24 stand rejected under 35 U.S.C. 103(a) as being obvious over Reed (U.S. Patent No. 5,313,065) in view of Attix (U.S. Patent No. 5,006,714) and further in view of Inaba (U.S. Patent No. 5,331,961).

The present claims particularly point out new and unobvious features of the invention which are not found in any reference and which would not have been obvious from the references. Nothing in each of the references teaches or suggests the claimed features. Therefore, the references cannot anticipate nor render obvious the present invention as claimed.

Claim 23 is patentable over Reed in view of Attix and further in view of Inaba.

Claim 1 is patentable over Reed and Attix as described above. Claim 23 adds patentable features to claim 1, namely, that the scintillator further comprises at least one additional individual scintillator body wherein each additional body is comprised of scintillator material, surfaces for directing photons toward a photon output for receiving and conducting the photons produced by the scintillator, a plurality of light-conducting optical fibers wherein each fiber has a proximal and a distal end and wherein the proximal end of each fiber is optically coupled to the photon output, and a holder for holding the scintillator bodies in an array. These patentable features are not found in the cited references. This is not obvious from Reed, Attix, Inaba or any combination thereof.

As described above, Reed teaches a fiber optic radiation monitor with a scintillating optical fiber 20. The scintillating optical fiber has aligned sections, dichroic mirrors 22 and an extension fiber 40, but does not have a single fiber or multiple fibers optically coupled to a scintillator.

Reed does not have the structure as described in the claims of the application. The single optic extension fiber of Reed is attached as a continuation of a scintillating fiber. Reed has an extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror.

Therefore, Reed does not have fibers connected to a scintillator, does not have photocouplers, and does not have coupling lens arrays as described in the Applicant's claims.

The Examiner has cited Attix as teaching a light conducting means formed from a plurality of fibers. However, there would have been no motivation inherent in Reed or Attix to combine one with the other. It is requested that any rejection based on a combination of Reed and Attix be withdrawn.

Any attempt to modify the teachings of Reed by adapting Attix's multiple fiber optic bundle, as done in hindsight reconstruction by the Examiner, will do harm to the Reed device, because Reed expressly teaches a single fiber for conducting light. The bundle of optical fibers found in Attix does not correspond to the single fiber in Reed. As stated above, Reed has an extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror. This is not true for Attix. Contrary to the Examiner's contention, merely because the references each teach scintillator detection devices does not necessitate a combination of the references.

The Examiner has cited Inaba as suggesting additional scintillator bodies. However, Inaba has a scintillator probe for insertion in a fine tube in a body cavity of a living animal (See Column 1, lines 62 – 64) to detect cancer. Inaba's thin scintillator for use in a thin tube in an animal body cavity has no relation with Reed or Attix. Therefore, there is no motivation for combination with Reed or Attix.

No combination of Inaba and Reed or Attix should be made. The law is replete with holdings that an Examiner may not pick elements from references and combine them without some suggestion for their combination arising in the references themselves. The decision to combine various aspects of different references would not have been a matter of "routine design choice" as suggested by the Examiner.

Nothing in the references, either singly or in combination, teaches or suggests the claimed features. Therefore, the references cannot anticipate nor render obvious the present invention as claimed.

Claim 1 is patentable over Reed in view of Attix and further in view of Inaba.

<u>Claim 24 is patentable over Reed in view of Attix and further in view of Inaba.</u>

Claim 24 adds patentable features to claim 23, which is dependent on claim 1, namely, a plurality of micro lenses connected to each additional scintillator body for coupling the body to the proximal ends of optical fibers. This is not obvious from Reed, Attix, Inaba or any combination thereof.

This is not a mere design choice. Nothing in the references suggest this feature of Applicant's invention.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

<u>Claims 25-27 are patentable under 35 U.S.C. 103(a) as being non-obvious over Reed (U.S. Patent No. 5,313,065) in view of Attix (U.S. Patent No. 5,006,714) and further in view of Inaba (U.S. Patent No. 5,331,961) and further in view of Kaufman (U.S. 2002/00870079 A1).</u>

The present claims particularly point out new and unobvious features of the invention which are not found in any reference and which would not have been obvious from the references. Nothing in each of the references teaches or suggests the claimed features. Therefore, the references cannot anticipate nor render obvious the present invention as claimed.

<u>Claim 25 is patentable over Reed in view of Attix and further in view of Inaba and further in view of Kaufman.</u>

Claim 1 is patentable over Reed and Attix and Inaba as described above. Claim 25 adds patentable features to claim 24, which is dependent on claim 1, namely, that the holder is flexible. These patentable features are not found in the cited references. This is not obvious from Reed, Attix, Inaba, Kaufman or any combination thereof.

The combination of four separate references to find obviousness seems excessive. The Applicant believes that the Examiner's need to use so many references just to assemble the Applicant's invention in hindsight renders the Applicant's invention non-obvious.

As described above, Reed teaches a fiber optic radiation monitor with a scintillating optical fiber 20. The scintillating optical fiber has aligned sections, dichroic mirrors 22 and an extension fiber 40, but does not have a single fiber or multiple fibers optically coupled to a scintillator.

Reed does not have the structure as described in the claims of the application. The single optic extension fiber of Reed is attached as a continuation of a scintillating fiber. Reed has an extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror.

Therefore, Reed does not have fibers connected to a scintillator, does not have photocouplers, and does not have coupling lens arrays as described in the Applicant's claims.

The Examiner has cited Attix as teaching a light conducting means formed from a plurality of fibers. However, there would have been no motivation inherent in Reed or Attix to combine one with the other. It is requested that any rejection based on a combination of Reed and Attix be withdrawn.

Any attempt to modify the teachings of Reed by adapting Attix's multiple fiber optic bundle, as done in hindsight reconstruction by the Examiner, will do harm to the Reed device, because Reed expressly teaches a single fiber for conducting light. The bundle of optical fibers found in Attix does not correspond to the single fiber in Reed. As stated above, Reed has an extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror. This is not true for Attix. Contrary to the Examiner's contention, merely because the references each teach scintillator detection devices does not necessitate a combination of the references.

The Examiner has cited Inaba as suggesting additional scintillator bodies. However, Inaba has a scintillator probe for insertion in a fine tube in a body cavity of a living animal (See Column 1, lines 62 – 64) to detect cancer. Inaba's thin scintillator for use in a thin tube in an animal body cavity has no relation with Reed or Attix. Therefore, there is no motivation for combination with Reed or Attix.

No combination of Inaba and Reed or Attix should be made. The law is replete with holdings that an Examiner may not pick elements from references and combine them without some suggestion for their combination arising in the references themselves. The decision to combine various aspects of different references would not have been a matter of "routine design choice" as suggested by the Examiner.

Kaufman has a delay line 42 in a catheter that sends electrical signals to a proximal end. Kaufman places a catheter in body lumen next to radioactively labeled regions. Kaufman has a delay line 42 in the catheter head which sends electrical signals to a signal processor outside the catheter, and thus would have lead away from the present invention even had it been combined with Reed. There is absolutely nothing in Kaufman, Reed, Attix, or Inaba that would have suggested their mutual combination in a manner proposed by the Examiner.

Nothing in the references, either singly or in combination, teaches or suggests the claimed features. Therefore, the references cannot anticipate nor render obvious the present invention as claimed.

Claim 1 is patentable over Reed in view of Attix and further in view of Inaba and further in view of Kaufman.

<u>Claim 26 is patentable over Reed in view of Attix and further in view of Inaba and further in view of Kaufman.</u>

Claim 26 adds patentable features to claim 24, which is dependent on claim 1, namely, that the holder is resilient. This is not obvious from Reed, Attix, Inaba, Kaufman or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 27 is patentable over Reed in view of Attix and further in view of Inaba and further in view of Kaufman.

Claim 27 adds patentable features to claim 24, which is dependent on claim 1, namely, that the holder is elongated and flexible and the plural scintillator bodies are arranged axially in the holder. This is not obvious from Reed, Attix, Inaba, Kaufman or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claims 28-32 stand rejected under 35 U.S.C. 103(a) as being obvious over Reed (U.S. Patent No. 5,313,065) in view of Attix (U.S. Patent No. 5,006,714) and further in view of Inaba (U.S. Patent No. 5,331,961) and further in view of Kaufman (U.S. 2002/00870079 A1), and further in view of Bourdinaud (U.S. Patent No. 5,103,099).

The present claims particularly point out new and unobvious features of the invention which are not found in any reference and which would not have been obvious from the references. Nothing in each of the references teaches or suggests the claimed features. Therefore, the references cannot anticipate nor render obvious the present invention as claimed.

Claim 28 is patentable over Reed in view of Attix and further in view of Inaba and further in view of Kaufman and further in view of Bourdinaud.

Claim 1 is patentable over Reed and Attix and Inaba and Kaufman as described above. Claim 28 adds patentable features to claim 23, which is dependent on claim 1, namely, a plurality of optical couplers provided on sides of the scintillator bodies, wherein each optical coupler couples the proximal end of an optical fiber to a scintillator body. These patentable features are not found in the cited references. This is not obvious from Reed, Attix, Inaba, Kaufman, Bourdinaud or any combination thereof.

The combination of five separate references to find obviousness seems excessive. The Applicant believes that the Examiner's need to use so many references just to assemble the Applicant's invention in hindsight renders the Applicant's invention non-obvious.

As described above, Reed teaches a fiber optic radiation monitor with a scintillating optical fiber 20. The scintillating optical fiber has aligned sections, dichroic mirrors 22 and an

extension fiber 40, but does not have a single fiber or multiple fibers optically coupled to a scintillator.

Reed does not have the structure as described in the claims of the application. The single optic extension fiber of Reed is attached as a continuation of a scintillating fiber. Reed has an extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror.

Therefore, Reed does not have fibers connected to a scintillator, does not have photocouplers, and does not have coupling lens arrays as described in the Applicant's claims.

The Examiner has cited Attix as teaching a light conducting means formed from a plurality of fibers. However, there would have been no motivation inherent in Reed or Attix to combine one with the other. It is requested that any rejection based on a combination of Reed and Attix be withdrawn.

Any attempt to modify the teachings of Reed by adapting Attix's multiple fiber optic bundle, as done in hindsight reconstruction by the Examiner, will do harm to the Reed device, because Reed expressly teaches a single fiber for conducting light. The bundle of optical fibers found in Attix does not correspond to the single fiber in Reed. As stated above, Reed has an extension fiber 40 and several sections of the scintillating fiber 20 with dichroic mirrors 22 disposed between each individual dichroic mirror. This is not true for Attix. Contrary to the Examiner's contention, merely because the references each teach scintillator detection devices does not necessitate a combination of the references.

The Examiner has cited Inaba as suggesting additional scintillator bodies. However, Inaba has a scintillator probe for insertion in a fine tube in a body cavity of a living animal (See Column 1, lines 62 – 64) to detect cancer. Inaba's thin scintillator for use in a thin tube in an

animal body cavity has no relation with Reed or Attix. Therefore, there is no motivation for combination with Reed or Attix.

No combination of Inaba and Reed or Attix should be made. The law is replete with holdings that an Examiner may not pick elements from references and combine them without some suggestion for their combination arising in the references themselves. The decision to combine various aspects of different references would not have been a matter of "routine design choice" as suggested by the Examiner.

Kaufman has a delay line 42 in a catheter that sends electrical signals to a proximal end. Kaufman places a catheter in body lumen next to radioactively labeled regions. Kaufman has a delay line 42 in the catheter head which sends electrical signals to a signal processor outside the catheter, and thus would have lead away from the present invention even had it been combined with Reed. There is absolutely nothing in Kaufman, Reed, Attix, or Inaba that would have suggested their mutual combination in a manner proposed by the Examiner.

The Examiner has cited Bourdinaud as suggesting a second optical coupler connected to the scintillator body remote from the first optical coupler, and a second array of microlenses in the optical coupler for directing photons from a second part of the scintillator body to a second output and further comprising second optical fibers connected to the second output.

Bourdinaud has a thin plate 2 of scintillating material that receives radiation through one edge 8, and has fluorescent fibers 4 attached longitudinally along the plate. The fluorescent fibers 4 have portions 6 which are parallel, adjacent and attached to one of the two faces of the plate. The fluorescent fibers are excited by light on the plate.

Bourdinaud and Reed would have been mutually exclusive because Bourdinaud uses fluorescing cores in fibers to auto-generate wavelengths after a thin scintillator plate receives

radiation at its end. Nothing in Bourdinaud would have suggested combination with Reed.

Even if the references were so combined, both of the references lead away from the invention as specifically set forth in the claims. Bourdinaud's fluorescent fibers, excited by light from one side of the scintillator plate, have nothing to do with Reed or Attix or with the present invention.

Nothing in the references, either singly or in combination, teaches or suggests the claimed features. Therefore, the references cannot anticipate nor render obvious the present invention as claimed.

Claim 28 is patentable over Reed in view of Attix and further in view of Inaba and further in view of Kaufman and further in view of Bourdinaud.

<u>Claim 29 is patentable over Reed in view of Attix and further in view of Inaba and further in view of Kaufman and further in view of Bourdinaud.</u>

Claim 29 adds patentable features to claim 28, which is dependent on claim 1, namely, that the optical couplers have square, polygonal, rectangular, oval or round cross-sections. This is not obvious from Reed, Attix, Inaba, Kaufman, Bourdinaud or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

<u>Claim 30 is patentable over Reed in view of Attix and further in view of Inaba and further in view of Kaufman and further in view of Bourdinaud.</u>

Claim 30 adds patentable features to claim 23, which is dependent on claim 1, namely, that the scintillators are angularly related to an axial direction of the holder, and wherein the proximal end of each of the optical fibers is connected to at least one lateral edge of one of the

scintillator bodies. This is not obvious from Reed, Attix, Inaba, Kaufman, Bourdinaud or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 31 is patentable over Reed in view of Attix and further in view of Inaba and further in view of Kaufman and further in view of Bourdinaud.

Claim 31 adds patentable features to claim 30, which is dependent on claim 1, namely, that the plurality of independent scintillators have square, polygonal, rectangular, oval, round cross-sections, or any other combination thereof. This is not obvious from Reed, Attix, Inaba, Kaufman, Bourdinaud or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

Claim 32 is patentable over Reed in view of Attix and further in view of Inaba and further in view of Kaufman and further in view of Bourdinaud.

Claim 32 adds patentable features to claim 30, which is dependent on claim 1, namely, that the angularly related plural independent scintillators have optical connectors at opposite side edges for connecting to first and second groups of optical fibers at opposite side edges of the plural bodies. This is not obvious from Reed, Attix, Inaba, Kaufman, Bourdinaud or any combination thereof.

Nothing in the references teaches, suggests or motivates one of ordinary skill in the art to combine the references in the manner proposed by the Examiner.

LEVEL OF ORDINARY SKILL IN THE ART

A person having ordinary skill in the art is an artisan being taught the reference teachings.

SUMMARY

When considering the present invention as a whole and the prior art to which the invention pertains as a whole, when considering the differences between the present invention and the prior art, and when considering the level of ordinary skill in the art to which the invention pertains, it is clear that the invention would not have been obvious under 35 U.S.C. 103 to a person having ordinary skill in the art at the time the invention was made.

CONCLUSION

Reversal of the Examiner and allowance of all the claims are respectfully requested.

Respectfully,

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CLAIMS APPENDIX

Appealed Claims:

1. Fiber optic enhanced scintillator apparatus, comprising a scintillator for producing photons upon being energized by particles, energy or rays, the scintillator further comprising a scintillator body made of scintillator material, surfaces on the body for directing photons toward a photon output for receiving and conducting the photons produced by the scintillator, and a plurality of light-conducting distinct and elongated optical fibers having a proximal and a distal end, and wherein the proximal end of each fiber is optically coupled to the photon output.

2. The apparatus of claim 1, further comprising a photon detector connected to the distal end of each of the optical fibers.

3. The apparatus of claim 2, wherein the optical fibers are long for reducing dark current.

4. The apparatus of claim 1, wherein the scintillator is ruggedized for use far below an earth surface, wherein the optical fibers extend from the scintillator far below the earth's surface to the detector which is mounted above the earth's surface.

5. The apparatus of claim 1, wherein the scintillator further comprises an optical coupler between the scintillator body and the output.

6. The apparatus of claim 5, wherein the optical coupler further comprises an array of micro lenses for directing photons from the scintillator body toward the output and the proximal end of the optical fibers.

7. The apparatus of claim 6, further comprising a second optical coupler connected to the scintillator body remote from the first optical coupler, and a second array of micro lenses in the second optical coupler for directing photons from a second part of the scintillator body to a

second output, and further comprising second multiple optical fibers connected to the second output.

8. The apparatus of claim 7, wherein the first and second outputs and each of the second multiple optical fibers have distal ends connected to a single detector.

10. The apparatus of claim 2, further comprising an electronic cooler connected to the detector.

11. The apparatus of claim 10, further comprising a magnetic field shielding surrounding the detector and the cooler.

12. The apparatus of claim 2, further comprising an electromagnetic field shielding surrounding the detector.

15. The apparatus of claim 1, further comprising a second output and first and second elastomeric optical coupler bodies connected to the scintillator body at different portions thereof for delivering photons from the scintillator body to the outputs, and for cushioning vibrations and impacts encountered by the scintillator.

23. The apparatus of claim 1, wherein the scintillator further comprises at least one additional individual scintillator body wherein each additional body is comprised of scintillator material, surfaces for directing photons toward a photon output for receiving and conducting the photons produced by the scintillator, a plurality of light-conducting optical fibers wherein each fiber has a proximal and a distal end and wherein the proximal end of each fiber is optically coupled to the photon output, and a holder for holding the scintillator bodies in an array.

24. The apparatus of claim 23, further comprising a plurality of micro lenses connected to each additional scintillator body for coupling the body to the proximal ends of optical fibers.

25. The apparatus of claim 24, wherein the holder is flexible.

26. The apparatus of claim 24, wherein the holder is resilient.

27. The apparatus of claim 24, wherein the holder is elongated and flexible and the plural scintillator bodies are arranged axially in the holder.

28. The apparatus of claim 23, further comprising a plurality of optical couplers provided on sides of the scintillator bodies, wherein each optical coupler couples the proximal end of an optical fiber to a scintillator body.

29. The apparatus of claim 28, wherein the optical couplers have square, polygonal, rectangular, oval or round cross-sections.

30. The apparatus of claim 23, wherein the scintillators are angularly related to an axial direction of the holder, and wherein the proximal end of each of the optical fibers is connected to at least one lateral edge of one of the scintillator bodies.

31. The apparatus of claim 30, wherein the plurality of independent scintillators have square, polygonal, rectangular, oval, round cross-sections, or any other combination thereof.

32. The apparatus of claim 30, wherein the angularly related plural independent scintillators have optical connectors at opposite side edges for connecting to first and second groups of optical fibers at opposite side edges of the plural bodies.

34. Fiber optic enhanced scintillator method, comprising providing a scintillator body made of scintillator material, providing surfaces on the body for directing photons toward a photon output, providing multiple light-conducting optical fibers having proximal and distal ends, connecting proximal ends of the optical fibers to the output for receiving photons from the output, and producing photons upon a scintillator being energized by subatomic particles, energy or rays.

35. The method of claim 34, further comprising connecting a photon detector to the distal ends of the single or multiple optical fibers.

36. The method of claim 35, further comprising providing the optical fibers as long optical fibers, and reducing dark current with the long optical fibers.

37. The method of claim 34, further comprising ruggedizing the scintillator for use far below an earth's surface, mounting the detector on the earth's surface, extending the optical fibers from the scintillator far below the earth's surface to the detector which is on the earth's surface, and transmitting photons from the scintillator through the optical fibers to the detector.

38. The method of claim 34, further comprising providing an optical coupler between the scintillator body and the output.

39. The method of claim 38, further comprising providing an array of micro lenses on the optical coupler, and directing photons from the scintillator body through the micro lenses and toward the output and the proximal ends of the single or multiple optical fibers.

40. The method of claim 39, further comprising providing a second optical coupler, and providing a second photon output on the scintillator body remote from the first optical coupler, and providing a second array of micro lenses on the second optical coupler, directing photons from a second part of the scintillator body to the second output, and providing second single or multiple optical fibers having proximal ends connected to the second output.

41. The method of claim 40, further comprising connecting distal ends of the first and second multiple optical fibers to a single detector.

43. The method of claim 35, further comprising connecting an electronic cooler to the detector.

44. The method of claim 43, further comprising surrounding the detector and the cooler with a magnetic field shielding.

45. The method of claim 35, further comprising surrounding the detector with an electromagnetic field shielding.

55. The method of claim 34, further comprising providing plural individual scintillator bodies, providing a holder connected to the scintillator bodies, holding the plural scintillator bodies in an array, and connecting proximal ends of the single or multiple optical fibers to each of the plural individual scintillator bodies.

56. The method of claim 55, further comprising providing plural micro lens arrays on the plural scintillator bodies, and directing photons from the plural scintillator bodies through the plural micro lens arrays to the proximal ends of the optical fibers.

57. The method of claim 56, further comprising providing a flexible and resilient holder.

58. The method of claim 55, further comprising providing an elongated holder and arranging the plural scintillator bodies in an axial array.

59. The method of claim 55, further comprising providing optical couplings on sides of the plural scintillator bodies, and coupling sides of the scintillator bodies to the proximal ends of the optical fibers.

60. The method of claim 59, wherein the plural scintillator bodies are provided with square, polygonal, rectangular, oval or round cross-sections.

61. The method of claim 55, wherein the providing of the plural scintillator bodies comprises providing a plurality of independent scintillators, angularly relating the independent

scintillators to each other, and connecting the proximal ends of the optical fibers to lateral edges of the angularly related independent scintillator bodies.

62. The method of claim 61, wherein the plural of scintillator bodies are provided with square, polygonal, rectangular, oval or round cross-sections.

63. The method of claim 61, further comprising providing optical connectors at opposite side edges of the angularly related plural scintillator bodies, and connecting the optical fibers to the optical connectors at the opposite side edges of the plural bodies.

65. The method of claim 34, further comprising connecting a detector to the distal ends of the optical fibers and cooling the detector with an electronic cooler surrounding the detector.

66. The method of claim 65, further comprising shielding the detector from magnetic fields by surrounding the detector with magnetic field shielding.

148. The apparatus of claim 1, wherein the scintillator is ruggedized for use far below an earth surface, wherein the optical fibers extend from the scintillator below the earth's surface to the detector which is mounted below the earth's surface and at a depth that minimizes the mechanical shock and a the temperature effects on the photosensor.

149. The apparatus of claim 5, where the optical coupler possesses special optical properties and can modify the light wavelength emitted from the scintillator to better match the photosensor.

150. The apparatus of claim 5, where the optical coupler possesses special optical properties and can modify the light wavelength emitted from the scintillator to better match the photosensor.

151. The apparatus of claim 24, wherein a space between the detectors is filled with an elastomer.

152. The apparatus of claim 151, where the optical coupler possesses special optical properties and can modify the light wavelength emitted from the scintillator to better match the photosensor.

153. The method of claim 34, wherein the scintillator is ruggedized for use far below an earth surface, wherein the optical fibers extend from the scintillator below the earth's surface to the detector which is mounted below the earth's surface and at a depth that minimizes the mechanical shock and a the temperature effects on the photosensor.

EVIDENCE APPENDIX

Original application, office actions and references of record.

RELATED PROCEEDINGS APPENDIX

There are no related proceedings.